UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P O Box 1450
Alexandria, Virginia 22313-1450
www uspto gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/677,191	10/02/2003	Gregory S. Glenn	PD-02-0360/11836 (21797-0	8302

7590 03/18/2008
Carmen Santa Maria
McNees Wallace & Nurick LLC
100 Pine Street
P.O. Box 1166
Harrisburg, PA 17108-1166

EXAMINER	
TRINH, THANH TRUC	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
03/18/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/677,191
Filing Date: October 02, 2003
Appellant(s): GLENN, GREGORY S.

Carmen Santa Maria
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed January 28, 2008 appealing from the Office action mailed August 24, 2007.

(1) Real Party In Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

4577051	Hartman	3-1986
5800630	Vilela et al.	9-1998
6313396	Glenn	11-2001
6993927	Austen et al.	02-2006
3451858	Dingwall	10-1965
6635507	Boutros et al.	10/2003

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

(I) Claims 1-15 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable by Glenn (US Patent 6313396) in view of Vilela et al. (US Patent 5800630).

Regarding claim 1, as seen in Figure 1, Glenn discloses a solar cell structure having a solar cell unit structure comprising a heat sink 20; a solar cell (11 or 12 or 13) having a front side 29, a back side 21, a solar cell projected area coverage on the heat sink, wherein the solar cell comprises an active semiconductor structure that produces a voltage between the front side and the back side when the front side is illuminated; and an intermediate structure (including all the layers between solar cells 11, 12, 13 and the heat sink) of disposed between and joined to the back side of the solar cell and to the heat sink, and having an intermediate structure projected area coverage on the heat sink. The intermediate structure further comprises a by-pass diode 15 having a diode projected area coverage on the heat sink. (See Figure 1 and col. 4 lines 10-31, 62-67 and col. 5 lines 1-19)

Regarding claim 2, Glenn discloses the diode projected area coverage on the heat sink is less than the solar cell projected area coverage on the heat sink, and wherein the intermediate structure further comprises a substrate (bonding element 18, dielectric layer 16, conducting element 17...) coplanar with the by-pass diode 15. (See Figure 1).

Regarding claim 3, Glenn discloses the diode projected area coverage on the heat sink is less than the solar-cell projected area coverage on the heat sink, and the intermediate structure further comprises a substrate (bonding element 18 and dielectric layer 16, conducting element 17...) coplanar with the by-pass diode 15 and having a substrate projected area coverage on the heat sink such that the diode projected area coverage on the heat sink and the substrate projected area coverage on the heat sink taken together are not less than the solar cell projected area coverage on the heat sink. (See Figure 1)

Regarding claim 4, Glenn discloses the diode projected area coverage on the heat sink is less than the solar cell projected area coverage on the heat sink, and the substrate has a substrate notch, and the by-pass diode is received into the substrate notch. (See Figure 1). It is the position of the examiner to consider the "notch" is a region in the substrate to have the diode. Glenn teaches the substrate having a region for the by-pass diode as shown in Figure 1. Therefore Glenn teaches the limitations of the instant claim.

Regarding claim 5, Glenn discloses the intermediate-structure projected area coverage on the heat sink is not less than the solar cell projected area coverage on the heat sink. (See Figure 1)

Regarding claim 6, Glenn discloses an intra-unit electrical connection structure (planar tab 14) operable to electrically interconnect the solar cell and the by-pass diode in an electrical anti-parallel relation. (See Figures 1).

Regarding claim 7, Glenn teaches the back side of the solar cell is substantially planar. (See Figure 1).

Regarding claim 8, Glenn describes that the solar cell structure includes at least one additional solar cell unit structure as set forth in claim 1, and further including a circuit electrical connection structure (metal trace 19, conducting element 17 and planar tab 14) operable to electrically interconnect each of the solar cell unit structures in series. (See Figure 1).

Regarding claim 9, Glenn discloses a solar structure as described in claim 1, wherein the solar cell structure includes a joint (metal trace 19 and conducting element 17) between the intermediate structure and the heat sink, and wherein the joint comprises a metallic trace deposited upon a dielectric (bonding 18). (See Figure 1 and col. 5 lines 24-26).

Regarding claim 10, Glenn describes that the solar cell structure includes a joint between the intermediate structure and the heat sink. (See Figure 1). The joint comprises metal trace 19, conducting element 17 and bonding 18. The structure of the joint is indistinguishable to a PC board having a metal trace on a face; therefore, the reference teaches the limitation of instant claim.

Regarding claim 11, Glenn discloses a solar cell structure 10 having a solar cell unit structure comprising a heat sink (20); a solar cell (11, 12 or 13); an intermediate structure (layers 15-19 between the heat sink 20 and solar cells 11, 12, and 13); an intra-unit electrical connection structure (tab 14). The solar cell has a front side 29, a back side 21, a projected area coverage on the heat sink, and inherently comprises an active semiconductor structure that produces a voltage between the front side and the back side when the front side is illuminated. The intermediate structure is disposed between and joined to the

back side of the solar cell and to the heat sink and having an intermediate-structure projected area coverage on the heat sink. The intermediate structure also comprises a by-pass diode 15 having a diode projected area coverage on the heat sink that is less than the intermediate-structure projected area coverage on the heat sink, and a substrate including layers 16-19 in which layers 16, 17 and 18 are coplanar with the by-pass diode 15. The substrate projected area coverage and the diode projected area coverage on the heat sink taken together are not less than the solar cell projected area coverage on the heat sink. And finally, the intra-unit structure operable to electrically interconnect the solar cell and the by-pass diode in an electrical anti-parallel relation. (See Figure 1 and col. 4 lines 24-31)

Regarding claim 12, Glenn describes the back side of the solar cell is substantially planar. (See Figure 1)

Regarding claim 13, Glenn discloses a solar cell structure further including a circuit electrical connection structure (metal trace 19, conducting element 17) operable to electrically interconnect each of the solar cell unit structures in series. (See Figure 1)

Regarding claim 14, Glenn discloses a solar cell structure as described in claim 11, wherein the solar cell structure includes a joint (metal trace 19 and conducting element 17) between the intermediate structure and the heat sink, and wherein the joint comprises a metallic trace (metal trace 19 or conducting element 17) deposited upon a dielectric layer 18. (See Figure 1 and col. 5 lines 24-26)

Regarding claim 15, Glenn describes that the solar cell structure includes a joint (metal trace 19, conducting element 17 and bonding 18) between the intermediate structure and the heat sink. (See Figure 1). The structure of the joint is not distinguishable to that of a PC board having a metal trace on a face. Therefore, Glenn teaches the limitation of the instant claim.

Regarding claim 21, Glenn describes the by-pass diode is attached by soldering or conductive adhesive. (See col. 4 lines 24-31). Therefore, the by-pass diode is a discrete by-pass diode. (See Figure 1)

Glenn does not specifically teach including a back-side metallization at the back side of the solar cell, but suggests using solar cells such as shown in Vilela et al. (US Patent 5800630). (See col. 4 lines 18-21).

Vilela et al. teach including a back-side metallization at the back side of the solar cell. (See Figure 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the solar cell structure of Glenn by utilizing back-side metallization as taught by Vilela et al., because it is suggested by Glenn.

(II) Claims 1, 5-8 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable by Hartman (US Patent 4577051) in view of Vilela et al. (US Patent 5800630).

Regarding claim 1, as seen in Figures 1-3, Hartman discloses a solar cell structure having a solar cell unit structure comprising a heat sink (22); a solar cell

(16) having a front side, a back side, a conductive substrate (15) and a projected area coverage on the heat sink, wherein the solar cell comprises an active semiconductor structure that produces a voltage between the front side and the back side when the front side is illuminated; an intermediate structure (combination of diode body 21, long leg 13 and short leg 14 of conductor strips 12) disposed between and joined to the conductive substrate 15 and heat sink (22). (See col. 3 lines 19-68 bridging col. 4 lines 1-43)

Regarding claim 5, as seen in Figures 1-2, Hartman discloses the intermediate structure (diode body 21, long leg 13 and short leg 14 of conductive strips 12) projected area coverage on the heat sink is not less than the solar cell projected area coverage on the heat sink.

Regarding claim 6, Hartman describes an intra-unit electrical connection structure (soldering or conductive adhesive – See col. 3 lines 38-44) operable to electrically interconnect the solar cell (16) and bypass diode (diode body 21, long leg 13 and short leg 14 of the conductive strips 12) in an electrical anti-parallel relation. (See Figures 1-3 and col. 4 lines 43-58).

Regarding claim 7, Hartman discloses the back side of the solar cell 16 is substantially planar. (See Figures 1-3)

Regarding claim 8, Hartman discloses solar cell structure having more than one solar cell unit as described in claim 1 connected in series. (See Figures 1-3, col. 5 lines 25-36). In order to connect solar cells in series, there must be a circuit electrical connection structure operable to electrically interconnect each of the solar cell unit structures in series. (See col. 5 lines 35-41)

Regarding claim 21, Hartman teaches the bypass diode is a discrete bypass diode. (See Figure 2)

Hartman does not specifically teach the conductive substrate 15 is made of metal, or having a back-side metallization.

Vilela et al. teach a solar cell having a back-side metallization. (See Fig. 1)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Hartman by utilizing a back-side metallization as taught by Vilela et al., because it would give a low resistance back contact (see col. 2 lines 13-14). In addition, it is conventional use a metallization layer for back contact or conductive substrate.

(III) Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable by Hartman (US Patent 4577051) in view of Vilela et al. (US Patent 5800630).

Regarding claim 16, as seen in Figures 1-3, Hartman discloses a solar cell structure having at least two solar cell unit structures, and each solar cell unit comprising a heat sink (22); a solar cell (16) having a front side, a back side, a conductive substrate (15) and a projected area coverage on the heat sink, wherein the solar cell comprises an active semiconductor structure that produces a voltage between the front side and the back side when the front side is illuminated; an intermediate structure (combination of diode body 21, long leg 13 and short leg 14 of conductor strip 12) disposed between and joined to the conductive substrate 15 and heat sink (22), See col. 3 lines 19-68 bridging col. 4 lines 1-43, wherein the intermediate structure comprises a bypass diode (body

21, long leg 13 and short leg 14 of conductive strip 12) having a diode projected area coverage on the heat sink (22) that is substantially the same as the intermediate-structure projected area coverage on the heat sink; an intra-unit electrical connection structure (soldering or conductive adhesive – See col. 3 lines 38-44) operable to electrically interconnect the solar cell and the by-pass diode in an electrical anti-parallel relation. The solar cell unit structures are electrically interconnected in series. (See Figures 1-3, col. 5 lines 25-36). Therefore, there must be a circuit electrical interconnection. (See col. 5 lines 35-41)

Regarding claim 17, as seen in Figures 1-2, Hartman discloses the intermediate structure (diode 21 and conductive strips 12) projected area coverage on the heat sink is not less than the solar cell projected area coverage on the heat sink.

Regarding claim 18, Hartman discloses the back side of the solar cell 16 is substantially planar. (See Figures 1-3)

Hartman does not specifically teach the conductive substrate 15 is made of metal, or having a back-side metallization.

Vilela et al. teach a solar cell having a back-side metallization. (See Fig. 1)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Hartman by utilizing a back-side metallization as taught by Vilela et al., because it would give a low resistance back contact. In addition, it is conventional use a metallization layer for back contact or conductive substrate.

(IV) Claims 9-10 and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable by Hartman (US Patent 4577051) in view of Vilela et al. (US Patent 5800630) and further in view of Glenn (US Patent 6313396).

Regarding claims 9 and 19, Hartman and Vilela et al. disclose a solar cell structure as described as claims 1 and 16. Hartman also describes a joint (20) between the intermediate structure (including diode body 21, long leg 13 and short legs 14 of conductor strips 12) and the heat sink (22). The joint (or diagonal arm 20) is made of very thin copper. (See col. 3 lines 30-35). Therefore, it is the Examiner's position that a very thin copper joint is a metallic trace.

Neither Hartman nor Vilela et al. teach the metallic trace deposited upon a dielectric.

Glenn teaches metal trace (19 and 17) deposited upon a dielectric layer 18. (See Figure 1 and col. 5 lines 24-26).

It would have been obvious to one ordinary skill in the art at the time the invention was made to modify the structure of Hartman and Vilela et al. by depositing the metal trace upon a dielectric as taught by Glenn, because it would provide bonding the conductive trace to the solar cell, and further support the solar cell. (See col. 5 lines 5-19).

With respect to claim 10 and 20, in such a combination described in claims 9 and 19, the structure of the copper joint (diagonal arm 20 of Hartman) deposited upon a dielectric layer (18 of Glenn) is not distinguishable from a structure of a PC board having a metal trace on a face. Therefore, it would have

been obvious to one skill in the art that metallic trace (20) deposited upon a dielectric layer (18) is the joint comprising a PC board with metal trace on a face.

(10) Response to Argument

Appellant's arguments filed in the Appeal Brief dated January 28, 2008 have been fully considered but they are not persuasive.

Ground (I): Claims 1-15 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable by Glenn (US Patent 6313396) in view of Vilela et al. (US Patent 5800630).

Appellant cites In re Vaeck for the proper requirements of proper analysis under 35 USC 103(a). The Examiner has considered the case law cited by Appellant and maintains that the rejection of claims 1-15 and 21 over Glenn in view of Vilela et al is proper.

Appellant argues that "[s]ubstrate 20 is in fact a substrate that is made of a dielectric (i.e., nonconducting) material, and is preferably a material such as Kapton film or glass fibers (col. 6, lines 31-44). Substrate 20 of the '396 patent cannot perform as a heat sink." Appellant argues that "[h]eat sinks are good conductors of heat, having good thermal conductivity, and accelerate the dissipation of heat as compared to a structure where there is no heat sink. Electrical nonconductors such as Kapton tend not to be good conductors of heat, do not conduct heat to any appreciable degree, and in fact are good thermal insulators, having low thermal conductivity." Appellant argues that the Examiner has recited an "insulator" rather than a "heat sink." However, these arguments

are not deemed to be persuasive for the following reasons. The Examiner maintains that the substrate 20 of Glenn can function as a heat sink. Indeed, at col. 6 lines 31-44, Glenn teaches the substrate 20 is made of a lightweight, dielectric material (or nonconductor of electricity) for saving launch cost and preventing electrical shorting, wherein the substrate 20 includes a relatively rigid frame 24 of graphite in one embodiment and a dielectric layer of Kapton adhering to a graphite substrate in another embodiment. There is in no way Glenn limits the substrate 20 to a thermal insulator when including a graphite material in the substrate 20, because graphite is well known for having a very good thermal conductivity. (See col. 4 lines 51-54 of A.G. F. Dingwall, US Patent 3451858). In the broadest interpretation given to the claim limitation, a heat sink is something that can transfer heat. Even though, dielectric materials (or nonconductor of electricity) such as Kapton or glass fibers have low thermal conductivity, they are not unable to transfer heat. Furthermore, besides some examples of material for a heat sink, there is nothing in the specification of the instant application that specifically defines "heat sinks" as "good conductor of heat, having good thermal conductivity, and accelerate the dissipation of heat." Appellant traverses the Examiner's position that "as long as substrate 20 has one surface area for absorbing heat and other surface areas for dissipating heat, the Examiner's believes that substrate 20 can perform as a heat sink." Appellant argues that "this statement suggests that there is no such thing as solid insulation, because all solid insulation will also have one surface for absorbing heat and another surface for dissipating heat. The proper line of analysis is not geometry, but instead is

whether the thermal conductivity of the heat-sink material is high so that it accelerates heat conduction, or low, so that it inhibits heat conduction. A material with high heat conductivity can be used as a heat sink, while a material with low heat conductivity can be used as an insulator." Appellant "further illustrates the level of skill in the art and what one skilled in the art would recognize as heat sink and how a heat sink operates" by showing equation: "$Q2= \lambda*A2(T1-T0)/l$

where Q2 is the amount of heat transfer, l is the length of the heat sink, A2 is the cross-sectional area of the heat sink and λ is the heat conductivity." Appellant argues that "the thermal conductivity of copper is identified at 400W/mK. By contrast, the thermal conductivity of Kapton is 0.12 W/mK... Thus, the thermal conductivity of Kapton is about 1/4000 that of copper, and one skilled in the art would select the material with a high thermal conductivity for a heat sink." However, these arguments are not deemed to be persuasive because the equation presented by the Appellant clearly shows that the heat transferring ability (or how a heat sink operates) depends not only on the heat conductivity but also on the surface area (A2), temperature difference (T1-T0) and thickness of the layer (l, or the length that heat has to travel). Accordingly, choosing a heat sink is not solely on the heat conductivity, i.e., one of ordinary skill would choose a low cost and lightweight material (as specified by Glenn at col. 6 lines 31-44) with large surface area and thin layer of a low thermal conductive substrate to transfer an appreciable amount of heat over an expensive and heavy material with high thermal conductivity, because the choice of material is also based on economical factor and condition of the application as stated by Glenn and

because the ratio of a large surface area to a thin layer can be large enough to easily compensate the poor thermal conductivity in material. Once the material is chosen, the heat conductivity is constant and the geometry variable plays a crucial role in heat transferring ability (as stated position of the Examiner in the rejection). The equation presented by the Appellant also clearly shows that a low thermal conductivity material does not inhibit heat conduction and that a low thermal conductivity material can function as a heat sink. According to the equation presented by the Appellant, as long as the coefficient heat of conductivity (λ), the surface area (A2), the temperature difference (T1 - T0), and the thickness of the layer (l) are non-zero, there is an amount of heat transferred; and how large of this amount of heat does not depend solely on the coefficient of heat conductivity, but also on the ratio of surface area to the thickness of layer, and the temperature difference. Again, reference to Glenn only limits substrate 20 to a dielectric material (or non-electrical conducting material), but does not limit substrate 20 to a thermal insulator when including a graphite layer or a graphite frame in the substrate.

Appellant also presents three exhibits to demonstrate glass fibers and Kapton are insulators. Appellant argues that "[e]xhibit 1 is part of The History of Spacesuits. As discussed in the very last sentence, speaking of the boots worn by those walking on the moon, who certainly did not want cold feet.

> 'The boot inner layers were made from Teflon-coated glass-fiber cloth followed by 25 alternating layers of

Kapton film and glass-fiber cloth to form an efficient, lightweight thermal insulation.'"

First of all, the Examiner cannot determine the validity of the "Exhibit 1" because there is no submission of this exhibit found. Secondly, the structure of "lightweight thermal insulation" described by the Appellant is not purely a layer of Kapton, but instead of Teflon-coated glass-fiber cloth followed by 25 alternating layers of Kapton film and glass fiber cloth. Thirdly, Glenn's surface area of a solar cell substrate such as substrate 20 in Glenn, which plays a part in heat transferring, is not the same as the surface area of a boot inner layers. Therefore, the Examiner maintains the position that Exhibit 1 is not commensurate in scope with the instantly appealed claims.

Appellant argues that "[e]xhibit 2 is an excerpt from U.S. Patent 6993927, which at col. 4 line –col. 5, line 25 discusses thermal insulation, specifically mentioning Kapton as a good material for use in thermal insulator." The Examiner has considered Exhibit 2 and maintains the position that this Exhibit is also not commensurate in scope with the instantly appealed claims. First of all, the Appellant appears to be arguing limitations that are not within the claims as claims 1 to 15 do not require anything about "thermal insulator." Secondly, there is nothing in this exhibit showing Kapton or glass fiber is a thermal insulator. Thirdly, the "thermal-insulation jackets" described in '927 can function to thermally insulate the electronic because of the cooling-agent (See Abstract of '927), and in a very short period of time, i.e., in term of seconds (See Figures 4 and 5). At col. 5 lines 20-25, '927 describes material such as Kapton is suited for

incorporation into thermal-insulation jacket. At col. 2 lines 62-65, ‘927 describes “[i]n use, at least a portion of jacket 10 is wetted with a liquid cooling-agent before jacket 10 and electronic device 20 are introduced into the heat environment." At col. 3 lines 31-48, ‘927 describes that “[a]fter being introduced into a heated environment, the temperature of the liquid cooling-agent will begin to increase. As the temperature rate of the liquid cooling-agent increase, the evaporation rate of the liquid cooling-agent also increases. The evaporation of the liquid cooling-agent consumes its characteristic latent heat of evaporation and, therefore, has a net cooling effect on absorbing material 16. In this way, the temperature of absorbing material 16 can be maintained for a prolonged period at a temperature well below the temperature of the environment.” The reference '927 clearly shows that there must be heat transferring, and this heat is transferred to the cooling-agent instead of to the electronic device to “thermally insulate” the electronic device because the temperature of the cooling-agent increases and causes it to evaporate. Also in Figures 4 and 5, '927 clearly shows that the temperature profile of the electronic device (204 in Figure 4, 304 in Figure 5) which is supposedly thermal insulated still increases gradually. There is nothing in this exhibit showing that substrate 20 of Glenn cannot transfer heat, or function as a heat sink.

Appellant argues that “Exhibit 3 is a printout from the website of Dass & Company, which discusses as one of its product Thermal Insulation Material, especially Kapton.” However, the Examiner only finds a submission of a technical data sheet of “Dupont™ Kapton® HN”. In this data sheet, there is no indication

that Kapton is a thermal insulator, but a coefficient of thermal conductivity of 0.12 W/mK in table 2. Again, this coefficient of thermal conductivity is not the only one factor in determining heat transferring of material as stated above (See equation presented by the Appellant).

Appellant argues that "[t]he Owens Corning website of Dass & Company as the inventor of glass fiber insulation, including PINK insulation products." Again, there is no copy or an address of this description or website submitted in order to determine the validity of this argument. However, the Examiner maintains the position that Glenn does not limit the substrate 20 to thermal insulator because material of good heat conductivity such as graphite is included in the substrate (See col. 6 lines 31-44 of Glenn).

Appellant continues to make generalization that "glass and Kapton are materials of low thermal conductivity and function as insulators, not as heat sinks." However, this generalization has no support in the evidences and exhibits submitted by the Appellant. These evidences and exhibits only point to the fact that "glass and Kapton" have low thermal conductivity, but nothing about "unable to transfer heat" or "cannot function as a heat sink". Again, substrate 20 of Glenn also includes graphite (see col. 6 lines 31-44 of Glenn) which has very high thermal conductivity.

Ground (II): <u>Claims 1, 5-8 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable by Hartman (US Patent 4577051) in view of Vilela et al. (US Patent</u>

5800630) for the reasons of record as set forth in the Final Rejection mailed August 24, 2007.

Appellant argues that the non-conductive reinforcing tape 22 of Hartman is not a heat sink, and that "the heat conductivity, or thermal conductivity of a material is crucial in determining whether a material can function effectively as a heat sink." However, this argument is not deemed to be persuasive because, as seen in the equation presented by the Appellant, the material is not the only factor that determines the heat transferring ability of a device as the Examiner has explained in Ground 1. There are other factors contributing to the ability of transferring heat, i.e., geometry factors such as surface area and thickness, and temperature difference.

In regard to the PC board, the Appellant argues that "the Examiner is once again either intentionally misstating what Applicant regards as his invention or does not understand the difference between a PC board and a metallic trace applied to a dielectric substrate. The premise is all PC boards are comprised of dielectric materials and include a metallic trace (Appellant does not know if this premise is correct); therefore, all dielectric substrates having a metallic trace are PC boards. This argument is not deemed to be persuasive. There is no rejection about a PC board in Ground II, claims 1, 5-8 and 21.

Appellant cites MPEP 2142, case laws: In re Fine, In re Laskowki, W.L. Gore & Associates v. Garlock, Inc., Ex parte Levengood, Ex parte Chicaga Rawhide Manufacturing Co., In re Jones, In re Mills for the proper requirements of proper analysis under 35 USC 103(a). The Examiner has considered the

MPEP and these case laws cited by Appellant and maintains that the rejection of claims 1, 5-8 and 21 over Hartman in view of Vilela et al. is proper.

Appellant argues that "there is no reason to believe that the '051 patent's depicted structure does not already provide a low resistance back contact. The '051 patent presumably provides a fully operational solar cell. It is additionally argued that the basis for the combination of teachings is 'conventional use.' This is a variation of a 'well known' argument. 'Well known' and 'commonly known' are not classes of statutory prior art recognized in 35 USC 102 or 35 USC 103." However, this argument is not deemed to be persuasive. As seen in Figures 1-3 of Hartman, Hartman discloses a solar structure having a solar cell unit structure comprising a heat sink (22); a solar cell (16) having a front side, a back side, a conductive substrate (15) and a projected area coverage on the heat sink, an intermediate structure which is a combination of diode body 21, long leg 13 and short leg 14 of conductor strips 12) disposed between and joined to the conductive substrate 15 and heat sink (22). (See col. 3, line 19 through col. 4 line 43 of Hartman). The difference between Hartman and the instant claims is that the requirement of substrate 15 to have a back-side metallization, or made of metal. Vilela et al. teach a solar cell having a back-side metallization. (See Figure 1). It would have been obvious to one skilled in the art to modify the device of Hartman by utilizing a back-side metallization as taught by Vilela et al. because it is conventional and well known that metallization contact has lower electrical resistance than other conductive material such as conductive polymer, because it is made from metal which is highly electrically conductive. Both

Hartman and Vilela et al. are concerned with solar cells and one would have a reasonable expectation of success from the combination.

Appellant argues that "[t]he '051 patent does not teach a heat sink. The explanation of the rejection identifies element 22 of the '051 patent as heat sink. Element 22 of the '051 patent is in fact a piece of 'non-conductive reinforcing tape 22' such as 'an adhesive backed polymer tape.' The reinforcing tape does not perform as a heat sink." Appellant argues that "Heat sinks are good conductors of heat and accelerate the dissipation of heat as compared to a structure where there is no heat sink. Nonconductors such as reinforcing tape 22 do not conduct heat to any appreciable degree, and in fact are good insulators." However, this argument is not deemed to be persuasive. As discussed in Ground 1, especially shown by equation presented by the Appellant $Q2 = \lambda*A2(T1-T0)/l$, the ability of conducting heat of a device (or layer) does not only depend on the coefficient of heat conductivity of a material, but also the temperature difference, the surface area and the thickness of the layer. According to the equation, the thickness of the layer is inverse proportional to the amount of heat transferred so that the thinner the layer, the larger the amount of heat will transfer. The "tape 22" disclosed by Hartman is obviously very thin which would compensate for the low heat conductivity of the polymer. Therefore the "tape 22" disclosed in Hartman can still function as a heat sink, and can dissipate an "appreciable degree" of heat. In addition, there is no definition such as "heat sinks are good conductors of heat and accelerate the dissipation of heat as compared to a structure where there is no heat sink" disclosed in the specification of the instant

application, and there is nothing in the claim language about using good thermal heat conducting material for the heat sink. In the broadest interpretation given to limitation of the claim, the Examiner considers anything that can conduct heat is a heat sink. The "tape 22" of Hartman can conduct heat because conducting heat does not solely depend on the coefficient of heat conductivity. Thus, the "tape 22" can function as a heat sink.

Appellant argues "[t]he patent has no relevant teaching. The combination of the two references, therefore, cannot teach the limitations of claim 1" without giving any explanation. Therefore, the argument is not persuasive. As explained above, both Hartman and Vilela et al. are concerned with solar cells, one would have reasonable expectation of success from the combination.

In regard to claim 5, Appellant argues "claim 5 recites in part: 'the intermediate-structure projected area coverage on the heat sink is not less than the solar cell projected area coverage on the heat sink." The explanation of the rejection relies on Figures 1-2 of the '051 patent. Figures 1-2 of the '051 patent do not even show the relevant features in the pertinent view. The plan view of Figure 1 does not show the solar cell 16 at all. As discussed in relation to the Ground 1 rejection of claim 1, one cannot tell about the projected area from a side view such as Figure 2 of the '051 patent, because it does not show the third dimension. In fact, one must look to Figure 3 of the '051 patent to see the relative projected areas. As shown in Figure 3, the projected area of the solar cell is much, much larger than the projected areas of the intermediate structure as identified by the Examiner." This argument is not deemed to be persuasive.

There is no need for third dimension in finding an area. First of all, Figure 1 shows the bottom view of a part of the solar cell where the diode and "heat sink 22" are attached, and Figure 2 shows the cross section of Figure 1 with the solar cell (16) and conductive substrate (15). Secondly, claim 5 recites "the intermediate structure projected area coverage <u>on the heat sink</u> is not less than the solar cell projected area coverage <u>on the heat sink.</u>" (emphasis added). Figures 1-2 show adequate information about projected areas on the heat sink (22), because the heat sink (22) in Hartman does not extend entire area of the solar cell. Figure 2 shows the projected width of the intermediate structure (the combination of diode body 21, long legs 13, strips 12) on the heat sink (or "tape 22") is longer than projected width of the solar cell 16 on the heat sink, because of the strips 12 extend beyond the gap of two solar cells 16. Figure 1 shows the projected length of the solar cell on the heat sink is the same as the width of the heat sink, and the projected area of the intermediate structure (including short leg 14) is substantially the same as the width of the heat sink. In the combination of the projected width and the projected length to form the projected area, the projected area of the intermediate structure on the heat sink is obviously not less than the solar cell projected area coverage on the heat sink.

In regard to claim 6, the Appellant argues "[c]laim 6 recites in part: 'an intra-unit electrical connection structure operable to electrically interconnect the solar cell and the bypass diode in an electrical anti-parallel relation.' The '051 patent has no such teaching of an "anti-parallel" interconnection at col. 4 lines 43-58 or elsewhere." However, this argument is not persuasive. The teaching of

"anti-parallel" is in the word "bypass diode". A diode can only function as a bypass diode when it is connected anti-parallel with the solar cell in order to stop the current going backward as intended. A bypass diode must be connected in an electrical anti-parallel relation for it to "bypass" the current. For better understanding of how a "bypass diode" has to be connected and works, please see US Patent 6635507, especially Figure 1B.

In regard to claim 8, the Appellant argues "[c]laim 8 recites in part: 'a circuit electrical connection structure operable to electrically interconnect each of the solar cell unit structures in series.' Although col. 5 lines 25-27 of the '051 patent state that twelve solar cells 16 were connected in series, there is no teaching of how that series connection was accomplished. The Examiner replies that in order for the solar cells connected in series there <u>must be</u> a circuit electrical connection structure (such as wires) connecting the solar cells. Therefore, '051 patent teaches the limitation of the claim when describing the solar cells connected in series.

Ground (III): <u>Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable by Hartman (US Patent 4577051) in view of Vilela et al. (US Patent 5800630) for the reasons of record as set forth in the Final Rejection mailed August 24, 2007.</u>

Appellant argues that "[a] 'non-conductive reinforcing tape' either electrically or thermally, teaches directly away from what the Applicant claims, and the Examiner cannot incorporate an interpretation of a 'non-conductive

reinforcing tape 22' that is contrary to what those skilled in the art would understand a non-conductive reinforcing tape to be." The Examiner replies that the term “non-conductive” in Hartman is implying to non-conducting of electricity, because the “non-conductive" tape 22 is connecting two terminals (positive and negative) of a diode as seen in Figures 1-2, one skilled in the art must use an electrical nonconductive material to separate these two terminals, otherwise short circuit will occur (note: this is the same reason that Glenn uses a dielectric substrate in '396). Hartman further specifies the non-conductive reinforcing tape is a polymer. Therefore the non-conductive tape in Hartman is non-electrical conductive, and not non-thermal conductive. One skilled in the art can always consider a polymer to be able to conduct heat as explained in Grounds 1 and 2.

In regard to claim 16, Appellant argues that “[c]laim 16 recites in part: ‘a heat sink.’ As noted, neither reference teaches a heat sink.” The Examiner replies that reinforcing tape 22 of Hartman is a heat sink as explained in Ground 2 and the paragraph above. Appellant argues that “[c]laim 16 further recites in part: ‘the solar cell includes a back-side metallization at the back side.’ Neither reference teaches this limitation. The ‘051 patent does not teach a metallization at the back side. The ‘051 patent teaches that the back of the solar cell is defined by a substrate 15. The ‘630 patent teaches a structure that is contrary to teaching of the ‘051 patent that the back side of the solar cell is defined by the substrate 15. In design of the ‘630 patent, the back side is formed below the substrate 112. A person skilled in the art, who does not have the benefit of the present disclosure, would not know whether to put the substrate as the back side, as in

Hartman, or the metallization as the back side, as in the '630." However, Appellant's argument is not deemed to be persuasive. As seen in Figures 1-3, Hartman discloses a solar cell structure having at least two solar cell unit structures, and each solar cell unit comprising a heat sink (22); a solar cell (16) having a front side and a back side; and intermediate structure (combination of diode body 21, long leg 13 and short leg 14 and conductor strip 12) disposed between and joined to the conductive substrate (15) of the solar cell (16) and heat sink (22) and having an intermediate-structure projected area coverage on the heat sink, wherein the intermediate structure comprises a bypass diode (body 21, long leg 13, short leg 14 and conductive strip 12) having a diode projected area coverage on the heat sink that is substantially the same as the intermediate-structure projected area coverage on the heat sink and a intra unit electrical connection (soldering or conductive adhesive - See col. 3 lines 38-44 operable to electrically interconnect the solar cell and the by-pass diode in an electrical anti–parallel relation. Hartman also teaches the solar cell unit structure are electrically interconnected in series (See Figures 1-3, col. 5 lines 25-36); thus, there must be a circuit electrical connection structure (such as wires) connecting the solar cells in series. The difference between Hartman and instant claim is the requirement for back-side metallization at the back side of the solar cell. Vilela et al. teach a solar cell having a back-side metallization as seen in Figure 1. It would have been obvious to one skill in the art at the time the invention was made to metallize the back side of Hartman's solar cell as taught by Vilela et al., because a metal backside conventionally can give a low resistance back contact. Because

both Hartman and Vilela et al. are concerned with solar cell, especially Hartman's intention is to electrically connect the back side of the solar cell to a diode, one would have reasonable expectation and benefit of having a low resistance contact between the solar cell and the diode from the combination. The Appellant argues "[c]laim 16 further recites in part: 'an intra-unit electrical connection structure operable to electrically interconnect the solar cell and the bypass diode in an electrical anti-parallel relation.' The '051 patent has no such teaching of an 'anti-parallel' interconnection at col. 4 lines 43-58 or elsewhere." However, this argument is not persuasive. The teaching of "anti-parallel" is in the word "bypass diode". A diode can only function as a bypass diode when it is connected anti-parallel with the solar cell in order to stop the current going backward as intended. A bypass diode must be connected in an electrical anti-parallel relation for it to "bypass" the current. For better understanding of how a "bypass diode" has to be connected and works, please see US Patent 6635507, especially Figure 1B. The Appellant argues "[c]laim 16 recites in part: 'a circuit electrical connection structure operable to electrically interconnect each of the solar cell unit structures in series.' Although col. 5 lines 25-27 of the '051 patent state that twelve solar cells 16 were connected in series, there is no teaching of how that series connection was accomplished." The Examiner replies that in order for the solar cells connected in series there must be a circuit electrical connection structure (such as wires) connecting the solar cells. Therefore, '051 patent teaches the limitation of the claim when describing the solar cells connected in series.

In regard to claim 17, Appellant argues "claim 17 recites in part: 'the intermediate-structure projected area coverage on the heat sink is not less than the solar cell projected area coverage on the heat sink.' The explanation of the rejection relies on Figures 1-2 of the '051 patent. Figures 1-2 of the '051 patent do not even show the relevant features in the pertinent view. The plan view of Figure 1 does not show the solar cell 16 at all. As discussed in relation to the Ground 1 rejection of claim 1, one cannot tell about the projected area from a side view such as Figure 2 of the '051 patent, because it does not show the third dimension. In fact, one must look to Figure 3 of the '051 patent to see the relative projected areas. As shown in Figure 3, the projected area of the solar cell is much, much larger than the projected areas of the intermediate structure as identified by the Examiner." This argument is not deemed to be persuasive. There is no need for third dimension in finding an area. First of all, Figure 1 shows the bottom view of a part of the solar cell where the diode and "heat sink 22" are attached, and Figure 2 shows the cross section of Figure 1 with the solar cell (16) and conductive substrate (15). Secondly, claim 17 recites "the intermediate structure projected area coverage <u>on the heat sink</u> is not less than the solar cell projected area coverage <u>on the heat sink.</u>" (emphasis added). Figures 1-2 show adequate information about projected areas on the heat sink (22), because the heat sink (22) in Hartman does not extend entire area of the solar cell. Figure 2 shows the projected width of the intermediate structure (the combination of diode body 21, long legs 13, strips 12) on the heat sink (or "tape 22") is longer than projected width of the solar cell 16 on the heat sink, because

of the strips 12 extend beyond the gap of two solar cells 16. Figure 1 shows the projected length of the solar cell on the heat sink is the same as the width of the heat sink, and the projected area of the intermediate structure (including short leg 14) is substantially the same as the width of the heat sink. In the combination of the projected width and the projected length to form the projected area, the projected area of the intermediate structure on the heat sink is obviously not less than the solar cell projected area coverage on the heat sink.

Ground (IV): <u>Claims 9-10 and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable by Hartman (US Patent 4577051) in view of Vilela et al. (US Patent 5800630) and further in view of Glenn (US Patent 6313396) for the reasons of record as set forth in the Final Rejection mailed August 24, 2007.</u>

Appellant argues that "[t]he Examiner further displays a lack of understanding of what is meant by depositing a metallic trace, as that term is used and understood by those skilled in the art. In the Final Office Action, the Examiner referred to col. 5 lines 24-26 of the '396 patent, and in the Advisory Action, the Examiner referred to col. 6 lines 8-10 and lines 31-33 as teaching deposition of a metallic trace. In fact, the Examiner further states that 'Glenn describes the metal traces 19 may be made by adhering a sheet of metal to substrate 20.' The Examiner either does not understand the difference between joining two different materials using an adhesive or is intentionally mischaracterizing the description of the adhesion of a metal sheet to the substrate using a bonding element or adhesive. Applicant utilizes the term

“depositing” as that term is understood by those in the art. Beyond that, the Applicant indicates at page 7, lines 3-19 what the term “depositing” means, and illustrates the difference between depositing and adhering. With regard to the Examiner’s assertion that the claim includes a process limitation, Applicant respectfully responds that the element described in a ‘product by process,’ and is used to distinguish over different forms of the metallic trace as described at page 7 of Applicant's specification." However, Appellant's argument is not deemed to be persuasive. At col. 5 line 60 through col. 6 line 19, col. 7 line 36 through col. 8 line 35 and Figures 1, 3A-B, 4 and 5A, Glenn describes conducting element 17 is applied to the openings 22 of the dielectric layer 18, and conductive traces 19 provided on the substrate 20 is then positioned on dielectric 18 to match the conducting element 17. Therefore the conducting element 17 and conductive traces 19 (or the joint between the intermediate structure and the heat sink) comprises a metallic trace (conductive traces 19) deposited upon a dielectric layer (bonding element 18). In addition, the term “deposited” is deemed to be a product-by-process limitation. The patentability of a product does not depend on its method of production, but on the product itself (See MPEP 2113). Furthermore, there is nothing at page 7 (or paragraph 0027) of Applicant's specification describing a specific method of depositing metallic traces (72) or describing a distinctive structural characteristic to the final product of “depositing” metal trace (72). Appellant argues that "it is difficult to see any basis for combining the teachings of Glenn with those of Hartman. The use of the diode tape 10 of Hartman requires access to the back side of the solar cell, but the

back side of the solar cell in the structure taught by Glenn is not accessible, because of the other structure taught by Glenn, see for example the structure shown in Figure 1." Appellant appears to be arguing limitations that are not within the claims as none of the claims requires an accessible backside solar cell or not accessible backside solar cell. As seen in Figures 1-3, Hartman discloses a solar cell structure, wherein a diode (21) is attached to the back of the solar cell (16) and connected to other diodes via conductor strips 12 and diagonal arms 20. As seen in Figures 1, 3A-B, 4, 5A, Glenn teaches a solar cell structure having a diode 15 attaching to the back of a solar cell (11, 12 or 13) and connecting to other solar cells and diodes via conducting element 17 and metal trace 19. For example, diagonal arm 20 of Hartman corresponds to conducting element 17 of Glenn. Glenn also teaches a dielectric layer such as bonding element where the conducting traces 19 formed upon. Therefore it would have been obvious to utilize a dielectric layer such as bonding element 18 taught by Glenn to form conducting traces upon, because Glenn teaches it would provide bonding the conductive trace to the solar cell and further support the solar cell (See col. 5 lines 5-19 of Glenn). Because both Hartman and Glenn are concerned with attaching and connecting a diode to the back of a solar cell, one would have a reasonable expectation of success from the combination.

In regard to claims 9 and 19, the Appellant argues that "[t]he explanation of the rejection asserts that the elements 17 and 19 constitute the recited metallic trace, and that the bonding element 18 constitutes the dielectric layer. The explanation of the rejection references Figure 1 and col. 5 lines 24-26 of Glenn.

Neither of these locations suggests that the metal trace 19 and the conducting element 17 are deposited upon the dielectric 18." However, Appellant's argument is not deemed to be persuasive. At col. 5 line 60 through col. 6 line 19, col. 7 line 36 through col. 8 line 35 and Figures 1, 3A-B, 4 and 5A, Glenn describes conducting element 17 is applied to the openings 22 of the dielectric layer 18, and conductive traces 19 provided on the substrate 20 is then positioned on dielectric 18 to match the conducting element 17. Therefore, the conducting element 17 and conductive traces 19 (or the joint between the intermediate structure and the heat sink) comprises a metallic trace (conductive traces 19) deposited upon a dielectric layer (bonding element 18). In addition, the term "deposited" is deemed to be a product-by-process limitation. The patentability of a product does not depend on its method of production, but on the product itself (See MPEP 2113). Furthermore, there is nothing at page 7 (or paragraph 0027) of Applicant's specification describing a specific method of depositing metallic traces (72) or describing a distinctive structural characteristic to the final product of "depositing" metal trace (72).

In regard to claims 10 and 20, the Appellant argues that "[t]here is no teaching that any of these elements is a PC board (printed circuit) board. The explanation of the rejection asserts that 'the structure of the joint is indistinguishable to a PC board having a metal trace on a face...' Appellant must respectfully disagree. A PC board is a specific structure. If the rejection is maintained, the Examiner must establish by evidence that the structure taught by Glenn is 'indistinguishable' from a PC board." However, this argument is not

persuasive. In a broadest reasonable interpretation given to the claim limitation, a structure of a PC board is a board having circuits. The structure of Glenn has exactly that structure. At col. 5 lines 20-29, Glenn teaches the bonding element 18 is preferably of a sheet construction, has a plurality of openings 22, and can have a varying thickness. At col. 5 lines 43-, Glenn further teaches the thickness of conducting elements 17 should be at least as thick as the bonding element 18 so that the conducting element can make contact with metal traces 19. (Also see Figures 1, 3A-B, 4 and 5B). The dielectric bonding element 18 in form of a sheet construction corresponds to the board, and conducting element 17 and metal traces 19 correspond to the circuit. Therefore the structure (dielectric bonding element 18, metal traces 19 or conducting elements 17) is not distinguishable from a structure of a PC board. The term “printed” in "printed circuit board" is deemed to be a product-by-process limitation. The patentability of a product does not depend on how the circuit is formed on the board, but on the final product itself (See MPEP 2113).

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner’s answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Thanh-Truc Trinh

March 3, 2008

Conferees:

/Thanh-Truc Trinh/

Examiner, Art Unit 1795

/Nam X Nguyen/

Supervisory Patent Examiner, Art Unit 1753

/Kathryn L Gorgos/

Kathryn Gorgos